Appl. No. 10/620,329
Amdt. dated April 5, 2007
Reply to Office Action of January 5, 2007

PATENT
Attorney Docket No.: 021318-000610US

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings of claims in the application:

Listing of Claims:

        1. - 29. (Canceled)

        30.   (New) An apparatus adapted to transcode an incoming bitstream coded for a first hybrid video codec to an outgoing bitstream coded for a second hybrid video codec, the apparatus comprising:

        a variable length decoder adapted to decode the incoming bitstream, the variable length decoder comprising:

                an input adapted to receive the incoming video bitstream;

                a first output providing motion vector information; and

                a second output providing first image information;

        a frame size conversion unit coupled to the variable length decoder and adapted to process the first image information to provide second image information; and

        a variable length encoder coupled to the variable length decoder and to the frame size conversion unit, the variable length encoder adapted to encode the outgoing bitstream, the variable length decoder comprising:

                a first input adapted to receive the motion vector information; and

                a second input adapted to receive the second image information.

        31.   (New) The apparatus of claim 30 wherein the frame size conversion unit does not perform a spatial scaling operation on the first image information to provide the second image information.

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32.   (New) The apparatus of claim 31 wherein a first frame size of a frame associated with the incoming video stream is different from a second frame size of a frame associated with the outgoing video stream.

33.   (New) The apparatus of claim 32 wherein the first frame size is compliant with SQCIF and the second frame size is compliant with QCIF.

34.   (New) The apparatus of claim 32 wherein the first frame size is compliant with QCIF and the second frame size is compliant with SQCIF.

35.   (New) The apparatus of claim 30 wherein the first image information and the second image information comprise coefficients coded in the transform domain.

36.   (New) The apparatus of claim 35 wherein the coefficients are Discrete Cosine Transform coefficients.

37.   (New) The apparatus of claim 30 wherein processing the first image information comprises passing the first image information through as the second image information.

38.   (New) The apparatus of claim 30 wherein the first image information comprises a first macroblock and the second image information comprises a second macroblock.

39.   (New) The apparatus of claim 30 wherein:
the first image information comprises a first frame;
the second image information comprises a second frame; and
processing the first image information comprises discarding any macroblocks in the first frame that lie outside a predetermined boundary.

40.   (New) The apparatus of claim 30 wherein:
the first image information comprises a first frame;

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the second image information comprises a second frame;

processing the first image information comprises adding macroblocks outside the first frame and inside the second frame.

41.   (New) The apparatus of claim 40 wherein processing the first image information further comprises adding macroblocks such that the first image information appears in the center of the second frame.

42.   (New) The apparatus of claim 40 wherein processing the first image information further comprises adding non-coded macroblocks if the first frame is a P frame.

43.   (New) The apparatus of claim 40 wherein processing the first image information further comprises adding intra coded macroblocks if the first frame is an I frame.

44.   (New) The apparatus of claim 30 further comprising a motion vector conversion unit adapted to process the motion vector information to produce second motion vector information, wherein the variable length encoder further comprises a third input adapted to receive the second motion vector information.

45.   (New) An apparatus adapted to transcode an incoming bitstream coded in a first hybrid video codec to an outgoing bitstream coded in a second hybrid video codec, the apparatus comprising:

a variable length decoder having:

an input adapted to receive the incoming video bitstream;

a first output providing image information associated with a first macroblock; and

a second output providing a plurality of first motion vectors associated with the first macroblock;

a conversion unit coupled to the variable length decoder, the conversion unit comprising:

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a processing unit adapted to provide image information associated with a second macroblock as a function of the image information associated with the first macroblock independent of the plurality of first motion vectors associated with the first macroblock;

a motion vector conversion unit adapted to convert the plurality of first motion vectors into a plurality of second motion vectors associated with the second macroblock; and

a variable length encoder coupled to the conversion unit, the variable length encoder having:

a first input adapted to receive the image information associated with the second macroblock;

a second input adapted to receive the plurality of second motion vectors; and

an output providing the outgoing bitstream.

46.   (New) The apparatus of claim 45 wherein the plurality of second motion vectors are the same as the plurality of first motion vectors.

47.   (New) The apparatus of claim 45 wherein the first hybrid video codec and the second hybrid video codec support different numbers of motion vectors per macroblock and a number of motion vectors supported by the second hybrid video codec is allowed by the second hybrid video codec.

48.   (New) The apparatus of claim 47 wherein converting the plurality of first motion vectors into the plurality of second motion vectors comprises:

replicating the plurality of first motion vectors to produce the plurality of second motion vectors if the second hybrid video codec supports more motion vectors per macroblock than a number of motion vectors per macroblock supported by the first hybrid video codec; and

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combining the plurality of first motion vectors to produce the plurality of second motion vectors if the second hybrid video codec supports fewer motion vectors per macroblock than the number of motion vectors per macroblock supported by the first hybrid video codec.

49.   (New) The apparatus of claim 48 wherein:

the plurality of first motion vectors comprise a plurality of incoming motion vectors;

the plurality of second motion vectors comprise a second motion vector; and

combining the plurality of first motion vectors comprises taking a mean or a median of the plurality of incoming motion vectors to compute the second motion vector.

50.   (New) The apparatus of claim 45 wherein:

a resolution of motion vectors allowed by the second hybrid video codec is less than a resolution of motion vectors allowed by the first hybrid video codec; and

converting the plurality of first motion vectors into the plurality of second motion vectors comprises rounding each of the plurality of first motion vectors to a nearest valid motion vector allowed by the second hybrid video codec.

51.   (New) The apparatus of claim 45 wherein a range for motion vectors for the first hybrid video codec lies outside a range for motion vectors allowed by the second hybrid video codec, wherein converting the plurality of first motion vectors into a plurality of second motion vectors associated with the second macroblock comprises modifying the plurality of first motion vectors to lie in the range for motion vectors allowed by the second hybrid video codec.

52.   (New) The apparatus of claim 51 wherein modifying the plurality of first motion vectors comprises clamping each component of the plurality of first motion vectors to a closest motion vector component value allowed by the second hybrid video codec.

53.   (New) The apparatus of claim 51 wherein the plurality of first motion vectors comprise a first motion vector and the plurality of second motion vectors comprise a

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second motion vector and modifying the plurality of first motion vectors comprises setting the second motion vector to be a largest motion vector allowed by the second hybrid video codec with a same direction as the first motion vector.

54.   (New) The apparatus of claim 51 wherein the plurality of first motion vectors comprise a first motion vector and the plurality of second motion vectors comprise a second motion vector and modifying the plurality of first motion vectors comprises, for a component of the first motion vector and a corresponding component of the second motion vector, setting each component of the first motion vector that is a value not allowed by the second hybrid video codec to a value allowed by the second hybrid codec and assigning it to the second motion vector.

55.   (New) The apparatus of claim 51 wherein the plurality of first motion vectors comprise a first motion vector and the plurality of second motion vectors comprise a second motion vector and modifying the plurality of first motion vectors comprises, for a component of the first motion vector and a corresponding component of the second motion vector:

setting the component of the second motion vector to be -16 if the component of the first motion vector is less than -16;

setting the component of the second motion vector to be 15.5 if the component of the first motion vector is greater than or equal to 16; and

setting the component of the second motion vector to be equal to the component of the first motion vector if the component of the first motion vector is neither less than -16 or greater than or equal to 16.

56.   (New) The apparatus of claim 45 wherein:

the image information associated with the first macroblock encodes a first portion of a first frame comprising a first frame size;

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the image information associated with the second macroblock encodes a second portion of a second frame comprising a second frame size;

the first frame size is not supported by the second hybrid video codec, and

converting the plurality of first motion vectors into a plurality of second motion vectors comprises:

determining the second frame size to be a smallest frame size allowed by the second hybrid video codec that is larger than the first frame size;

centering the second frame on the first frame; and

for areas of the second frame that lie outside a boundary defined by the first frame size, coding a suitable background color if the first frame is an I frame and coding as not coded macroblocks if the first frame is a P frame.

57.   (New) The apparatus of claim 45 wherein:

the image information associated with the first macroblock encodes a first portion of a first frame comprising a first frame size;

the image information associated with the second macroblock encodes a second portion of a second frame comprising a second frame size;

the first frame size is not supported by the second hybrid video codec, and

converting the plurality of first motion vectors into a plurality of second motion vectors comprises:

determining the second frame size to be a largest frame size allowed by the second hybrid video codec that is smaller than the first frame size;

centering the second frame on the first frame; and

cropping the first frame to produce the second frame, ignoring any macroblocks in first the frame that lie outside the boundary defined by the second frame size.

58.   (New) The apparatus of claim 45 wherein the plurality of second motion vectors are associated with a most recent decoded frame and the first hybrid video codec supports P frames that do not reference the most recent decoded frame and the second hybrid

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video codec supports P frames that reference the most recent decoded frame, the apparatus further adapted to process the plurality of first motion vectors, wherein the conversion unit is further adapted to scale the plurality of second motion vectors to reference the most recent decoded frame.

59.   (New) The apparatus of claim 58 wherein scaling the plurality of second motion vectors comprises dividing each component of the plurality of first motion vectors by the number of skipped reference frames plus one to produce the plurality of second motion vectors.

60.   (New) The apparatus of claim 45 wherein the conversion unit is adapted to convert a P frame encoded in part by the first image information to an I frame encoded in part by the second image information to correct for drift.

61.   (New) The apparatus of claim 45 wherein the conversion unit is further adapted to convert a P frame encoded in part by the first image information to an I frame encoded in part by the second image information to remain in conformance with a standard associated with the second hybrid video codec.

62.   (New) The apparatus of claim 61 wherein the standard is ITU-T Recommendation H.263 and the I frame is encoded if no I frame has been encountered associated with the first image information for a pre-determined number of frames.

63.   (New) The apparatus of claim 62 wherein the pre-determined number of frames is 131.